Translation of JP-A-1997140682

[Detailed Description of the Invention]

[0001]

[Field of the Invention] The present invention relates to a biological signal waveform display device, and particularly to a biological signal waveform display device which can display a biological signal on a single display device in a plurality of waveform display styles.

[0002]

[Background Art] Monitoring of biological signal can be achieved by displaying in a waveform continuous rhythm information about life-sustaining activities (for example, heart beat, etc.) or information about the state transition of a signal forming the rhythm. However, in a heart catheter examination, etc., it is desired to monitor both the kinds of information during the examination. Conventionally, there is a memory type biological signal waveform display device shown in FIG. 4.

[0003] The device can display a plurality of biological signals electrically detected from a living body on a CRT 8 in waveform display styles appropriate for respective signals. The device is configured with biological signal amplifiers 3_1-3_N which amplify biological signals input via CH1-CHN, a multiplexer 4 which selects and outputs a desired biological signal from the amplified biological signals, an A/D converter 5 which performs analog–to-digital conversion of the signal output by the multiplexer 4, a waveform signal video memory 6 which stores the output signal of the A/D converter 5, a video signal conversion circuit 7 which converts the signal stored in the waveform signal video memory 6 into a video signal, a CRT 8 which configures a display device and displays a waveform of the video signal, a horizontal synchronizing signal generating circuit 9 which outputs a horizontal synchronizing signal, a vertical synchronizing signal generating circuit 10 which outputs a vertical synchronizing signal, a timing control circuit 11 which provides a clock for the multiplexer 4, the A/D converter 5, the waveform signal video memory 6, the video signal conversion circuit 7, the horizontal synchronizing signal generating circuit 9, and the vertical synchronizing signal generating circuit 10 and controls an operation timing of each device, and a display style selection circuit 12 which can select a prescribed waveform display style.

[0004] An operation of FIG. 4 with the configuration described above will be described in detail. A plurality of kinds of signals detected from a living body are supplied to the biological signal amplifiers 3_1-3_N via the CH1-CHN. The biological signal amplifiers 3_1-3_N amplify the supplied weak signals to respective desired magnitudes and then output the amplified signals. The multiplexer 4 makes an appropriate selection from the output biological signals. The selected signal is sampled by the A/D converter 5. The A/D converter 5 samples a biological signal from the multiplexer 4 in response to the clock

provided from the timing control circuit 11 and writes the sampled biological signal to a predetermined address in the waveform signal video memory 6. An address to which a signal is written is different according to each waveform display style, and the details will be described later.

[0005] A biological signal written in the waveform signal video memory 6 is read out and converted into a video signal by the video singal conversion circuit 7. The video signal is supplied to the CRT 8 together with a horizontal synchronizing signal H-sync and a vertical synchronizing signal V-sync output by the horizontal synchronizing signal generating circuit 9 and the vertical synchronizing signal generating circuit 10, respectively, and a waveform is displayed. Generally, as waveform display styles for electrocardiogram, there are two kinds of waveform display styles, which are scrolling waveform signal style and fixed waveform signal style. Those styles are different in data writing or data access to the waveform signal video memory 6.

[0006] (1) Signal display control mode in the scrolling waveform signal style

An object of this waveform display style is to monitor a rhythm information of a living body. Since the waveform is continuously displayed from one end to the other end of the CRT 8, this style is suitable in a cardiac catheter examination not only for monitoring heart beat on the body surface but also for monitoring a follow-up characteristic, etc. of the stimulus conduction system to an imperative stimulus by a stimulus device.

[0007] The latest waveform signal data is displayed in a waveform at a right end of the CRT 8 (this is the right end as seen from an operator facing the CRT 8. It is similar for the left end.). The waveform is displayed while the whole waveform is gradually scrolled to the left. That is, when the latest data is written in the waveform signal video memory 6, each data stored from the right end to the left end of the CRT 8 is shifted to the left by one address, thereby scrolling the whole waveform on a screen to the left. Further, the latest data is written to an address corresponding to the right end of the CRT 8, and similar operations are repeated for following data. Since a continuous waveform is displayed while being scrolled in this waveform display style, if the sweep speed is set high, it becomes difficult to distinguish waveforms. Usually, a sweep speed of 100 mm/sec or less is used.

[0008] (2) Signal display control mode in the fixed waveform signal style

An object of this waveform display style is to monitor a state transition of a signal forming rhythm information. In a cardiac catheter examination, the P wave, Q wave, R wave, S wave, and T wave of an electrocardiogram is temporarily displayed in a static state, thereby allowing monitoring of a state transition of a waveform from an interrelationship between each wave. In an intracardiac electrocardiogram, detailed monitoring about the A wave, V wave, HIS bundle electrocardiogram, etc. can be performed.

[0009] The latest data is displayed at the left end of the CRT 8. A waveform signal is displayed while a next data is stepwise added to a next position on the right side. When

the waveform signal reaches at the right end, the data moves back to the left end, the old data is replaced by a new data, thereby making the CRT 8 display a waveform. Accordingly, after storing the latest data in an address of the waveform signal video memory 6 corresponding to the left end of the CRT 8, a next data is updated and stored in an address where a present address is incremented. Thereafter, when the data reaches the address corresponding to the right end of the CRT 8, a next data is updated and stored back in the address corresponding to the left end of the screen, and the operation is repeated.

[0010] Since the waveform is static until a whole screen is displayed, this waveform display style can support a wide range of sweep speeds from a low speed to a high speed. Particularly, this style is effective for a sweep at a high speed such as 200-400 mm/sec. However, since an image on the screen is interrupted by a break when display of a next image starts after displaying a whole screen, the style may be inconvenient for monitoring of rhythm information. The conventional biological signal waveform display device can display the waveform display in either style of waveform display style (1) or (2) by switching with the display style selection circuit 12.

[0011]

[Problem to be Solved by the Invention] Therefore, conventionally, the single biological signal waveform display device cannot simultaneously display waveforms in the scrolling waveform style and the fixed waveform style. Accordingly, there is a problem that when an operator desires to simultaneously observe waveforms in both the styles, the operator needs to prepare the biological signal waveform display devices for the respective waveform display styles. The present invention is to solve such a problem, and an object thereof is to provide a biological signal waveform display device which is capable of displaying waveforms in a plurality of waveform display styles on a single CRT.

[0012]

[Means for Solving the Problem] To achieve such an object, a biological signal waveform display device in accordance with the present invention includes waveform display circuits which individually process amplified biological signals for respective desired waveform display styles. With such a configuration, simultaneous waveform display in a plurality of waveform display styles can be realized on a single display device.

[0013]

[Embodiment of the Invention] Next, the present invention will be described in detail with reference to drawings. FIG 1 is a block diagram illustrating an embodiment of the present invention. The same numerals as FIG 4 denote the same or corresponding parts. In the drawing, reference numerals 1 and 2 denote waveform display circuits, a reference numeral 13 denotes a phase synchronizing circuit, and a reference numeral 14 denotes s a video signal adder circuit.

[0014] The waveform display circuits 1 and 2 have configurations generally similar to FIG 4. As such, the two waveform display circuits are provided, thereby allowing

simultaneous waveform display in two waveform display styles. The phase synchronizing circuit 13 receives horizontal synchronizing signals H-sync 1 and H-sync 2 and vertical synchronizing signals V-sync 1 and V-sync 2 output by the respective waveform display circuits 1 and 2, and synchronizes the input horizontal and vertical synchronizing signals in response to a clock provided from a timing control circuit 11a of the waveform display circuit 2. Then, the phase synchronizing circuit 13 outputs a new horizontal synchronizing signal H-sync and a new vertical synchronizing signal V-sync. Further, a pixel data clock 15 is provided to a video signal conversion circuit 7 in the waveform display circuit 1, thereby synchronizing video signals output from video signal conversion circuits 7 and 7a.

[0015] The video signal adder circuit 14 receives the video signals output by the respective video signal conversion circuit 7 and 7a, synthesizes the signals into a single video signal, and output the synthesized signal. The horizontal synchronizing signal H-sync, the vertical synchronizing signal V-sync, and the video signal output as described above are supplied to the CRT 8, and a waveform is displayed.

[0016] Additionally, it is possible to connect other waveform display circuit in a similar manner, thereby connecting three or more waveform display devices together. Further, if a plurality of sets of multiplexers, A/D converters, waveform video memorys, etc. are included in the single waveform display circuit, only preparing a single timing control circuit and a single video signal conversion circuit allows a construction of a device equivalent to the case that two waveform display circuits are included.

[0017] Operation of the present invention with the above-described configuration will be described in detail with reference to drawings. FIG 2 is a waveform chart representing an example of display on the CRT 8 in FIG 1, and is an example of waveform display for an examination of the conducting system of the heart in an cardiac catheter examination. The example shows three waveforms, which are an electrocardiogram waveform on the body surface in the scrolling waveform signal style in the upper portion of the screen, an enlarged waveform showing a part of the electrocardiogram waveform on the body surface in the fixed waveform signal style in the middle portion, and an intracardiac electrocardiogram waveform in the fixed waveform signal style in the lower portion. First, the display style selection circuit 12 previously sets the scrolling waveform signal style as a desired waveform display style. Similarly, a display style selection circuit 12a sets the fixed waveform signal style.

[0018] An electrocardiogram signal detected on the body surface is supplied to a biological signal amplifier 3_1 via a CH1. Similarly, an intracardiac electrocardiogram signal is supplied to a biological signal amplifier 3_2 via a CH2. Each of the signals is amplified to a desired magnitude. In the waveform display circuit 1, a multiplexer 4 selects an output signal of the biological signal amplifier 3_1. The signal is sampled by an A/D converter 5 and stored in a waveform signal video memory 6. The video signal

conversion circuit 7 reads out the signal stored in the waveform signal video memory 6 in response to a pixel data clock 15 output by the phase synchronizing circuit 13, converts the signal into a video signal, and outputs the video signal.

[0019] In the conversion, the video signal conversion circuit 7 applies a desired mask to the video signal and assigns a position for waveform display on the CRT 8. Together with the output of the video signal, the horizontal synchronizing signal H-sync 1 and the vertical synchronizing signal V-sync 1 are output from a horizontal synchronizing signal generating circuit 9 and a vertical synchronizing signal generating circuit 10, respectively, to the phase synchronizing circuit 13.

[0020] Similar operation is performed in the waveform display circuit 2. In the waveform display circuit 2, both biological signals of the CH1 and CH2 are selected by a multiplexer 4a. Each of the signals is sampled and converted into a video signal. The video signals, the horizontal synchronizing signal H-sync 2, and the vertical synchronizing signal V-sync 2 are output. Further, the video signal conversion circuit 7a operates in response to a clock output by a timing control circuit 11a in the waveform display circuit 2, applies desired masks to the video signals, and assigns displayed positions.

[0021] The horizontal synchronizing signals H-sync 1 and 2 and the vertical synchronizing signals V-sync 1 and 2 output from the waveform display circuits 1 and 2 as described above are supplied to the phase synchronizing circuit 13. The horizontal synchronizing signal H-sync and the vertical synchronizing signal V-sync are newly output. The video signals output from the waveform display circuits 1 and 2 are supplied to the video signal adder circuit 14 and synthesized into a single video signal. Thereafter, the synthesized video signal is supplied to the CRT 8 together with the horizontal synchronizing signal H-sync and the vertical synchronizing signal V-sync. Waveforms are displayed as in FIG 2.

[0022] FIG 3 is a waveform chart in a case that a trigger function and a delay time setting function are installed in the timing control circuit 11a. The trigger function is installed in the timing control circuit 11a, thereby allowing a waveform to be fixed on the CRT 8. In this case, the R wave is used as a trigger signal. Accordingly, although the waveform is replaced every beat in response to the heart beat, the R wave is always displayed in the same position. Further, the delay time setting function is included, thereby allowing movement of the waveform in the time axis direction. That is, the waveform can be moved to a position that is easily observed.

[0023]

[Effect of the Invention]

As described in the foregoing, the present invention includes the waveform display circuit for each of the desired waveform display styles. Accordingly, waveforms can be simultaneously displayed in the desired waveform display styles for the respective biological signals on the single display device. Also, the same biological signal can be

simultaneously displayed in the plurality of waveform display styles on the single display device. Further, the display style selection circuit is included, thereby allowing selection of the desired style corresponding to the biological signal. Therefore, it is not required to prepare a plurality of biological signal waveform display devices as in a conventional case. This allows improvements in economic feasibility and operability. Further, since the plurality of waveform display styles can be simultaneously observed on the single screen, monitoring capability of an operator can be improved, and examinations etc. can be more appropriate than a conventional device particularly in an examination of the physiological function and a treatment.

[Brief Description of Drawings]

FIG. 1 is a block diagram illustrating an embodiment of the present invention.

FIG. 2 is a waveform chart representing an example of display on a CRT 8 in FIG. 1.

FIG. 3 is a waveform chart representing another example of display on the CRT 8 in FIG. 1.

FIG. 4 is a block diagram illustrating a conventional device.

[Description of Reference Numerals]

1, 2: waveform display circuit

3_1–3_N: biological signal amplifier

4, 4a: multiplexer

5, 5a: A/D converter

6, 6a: waveform signal video memory

7, 7a: video signal conversion circuit

8: CRT

9, 9a: horizontal synchronizing signal generating circuit

10, 10a: vertical synchronizing signal generating circuit

11, 11a: timing control circuit

12, 12a: display style selection circuit

13: phase synchronizing circuit

14: video signal adder circuit

15: pixel data clock

[Claims]

[Claim 1] A biological signal waveform display device comprising: biological signal amplifiers outputting a plurality of electrically detected biological signals with the respective signals amplified; and a display device displaying waveforms of amplified biological signals,

wherein the biological signal waveform display device including waveform display circuits which individually process the amplified biological signals for respective desired waveform display styles, and the single display device displays a plurality of waveforms in the respective waveform display styles.

[Claim 2] The biological signal waveform display device according to claim 1,

wherein the waveform display circuit comprises a display style selection circuit which switches into either waveform display style of a scrolling waveform signal style or a fixed waveform signal style.

[Claim 3] The biological signal waveform display device according to claim 1 or 2, further comprising:

a video signal adder circuit which outputs a single video signal synthesized from video signals output from the waveform display circuits; and

a phase synchronizing circuit which unifies phases for horizontal synchronizing signals and vertical synchronizing signals output from the waveform display circuits and outputs unified signals to the display device.

[Abstract]

[Problem to be Solved] To simultaneously display waveforms of rhythm information of biological signals and of information about state transitions of signals forming the rhythms on a single display device in a examination of the physiological function of a living body and in a treatment.

[Solution] Waveform display circuits are installed for a number of desired waveform display styles. Video signals output from the respective waveform display circuits are synthesized into a single signal at a video signal adder circuit 14 and displayed on a CRT 8.

Translation of the description in the drawings

FIG 1

1: Waveform display circuit
2: Waveform display circuit
3_1: Biological signal amplifier
3_2: Biological signal amplifier
3_N: Biological signal amplifier
4: Multiplexer
4a: Multiplexer
5: A/D converter
5a: A/D converter
6: Waveform signal video memory
6a: Waveform signal video memory
7: Video signal conversion circuit
7a: Video signal conversion circuit
9: Horizontal synchronizing signal generating circuit
9a: Horizontal synchronizing signal generating circuit
10: Vertical synchronizing signal generating circuit
10a: Vertical synchronizing signal generating circuit
11: Timing control circuit
11a: Timing control circuit
12: Display style selection
12a: Display style selection
13: Phase synchronizing circuit
14: Video signal adder circuit

FIG 2

Scrolling waveform style
Fixed waveform style

FIG 3

Scrolling waveform style: Scrolling waveform style
Fixed waveform style: Fixed waveform style
Delay time
Trigger

FIG4

3_1: Biological signal amplifier
3_2: Biological signal amplifier
3_N: Biological signal amplifier
4: Multiplexer
5: A/D converter
6: Waveform signal video memory
7: Video signal conversion circuit
9: Horizontal synchronizing signal generating circuit
10: Vertical synchronizing signal generating circuit

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